

NATIONAL BUREAU OF STANDARDS REPORT

10 100

PERFORMANCE TEST OF A METAL VISCOUS IMPINGEMENT FILTER

Manufactured by

The Standard Filters Corporation
Florence, South Carolina

Report to

Defense Supply Agency
Defense Construction Supply Center
Columbus, Ohio



U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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¹ Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

² Located at Boulder, Colorado 80302.

³ Located at 5285 Port Royal Road, Springfield, Virginia 22151.

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NBS REPORT

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Manufactured by

The Standard Filters Corporation
Florence, South Carolina

by

Charles M. Hunt

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1. Introduction

At the request of the Defense Construction Supply Center of the Defense Supply Agency, the performance of a Standard Filters Corporation metal viscous impingement filter was determined. The performance tests were carried out at a face velocity of 360 ft./min. They included determination of arrestance of Cottrell precipitate dispersed in laboratory air and pressure drop across the filter as the dust load was increased stepwise from zero to an amount corresponding to a pressure drop greater than 0.5 in. W.G. The tests were performed with the filter in the as-received condition and again after cleaning and reapplication of an adhesive supplied by the manufacturer.

2. Description of Filter

The Standard Filters Corporation filter had nominal dimensions, 20 in. x 20 in. x 1 in. The actual gross dimensions were 19 1/2 in. x 19 1/2 in. x 7/8 in., while the area of the screen was 17 3/4 in. x 17 3/4 in., corresponding to a face area of 2.19 ft².

The media consisted of three layers of 18-mesh per inch aluminum wire screen folded into corrugations. The corrugations were about 5/8 inch deep and about 1 inch from peak to peak on the front screen, and about 1/8 inch deep and 5/16 inch from peak to peak on the other two screens. The corrugations on the latter two screens were oriented perpendicular to one another. The screens were coated with an adhesive.

3. Test Method and Procedure

The filters were tested at a face velocity of 360 ft./min. The arrestance determinations were made by means of the NBS Dust Spot Method described in a paper by R. S. Dill entitled, "A Test Method for Air Filters" (ASHVE Transactions, Vol. 44, page 379, 1938). The filter under test was installed in the test apparatus and carefully sealed to prevent any by-pass of air around the media. After establishing the correct air flow rate through the filter, samples of air were drawn from the center points of the test duct 1 foot upstream and 8 feet downstream of the test specimen. Each sample of air was passed through known areas of Whatman No. 41 filter paper. Arrestances were measured with Cottrell precipitate dispersed in laboratory air as the test aerosol.

The amount of light passing through the sampling papers was measured on the same area of each paper with a photometer before and after each test. The two sampling papers used for any one arrestance determination were selected to have the same light transmission when clean.

In determining arrestance, the areas of sampling paper upstream and downstream were selected so as to obtain dust spots of similar optical density. The arrestance was then calculated by the equation:

$$A = \left(1 - \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta U} \right) \times 100 \quad (1)$$

where A represents the percent arrestance, ΔU and ΔD represent the change in the amount of light transmitted through the upstream and downstream papers due to the dust spots, as indicated by the photometer readings, and S_U and S_D represent the areas of sampling paper upstream and downstream.

The test dust consisted of 96 parts by weight of Cottrell precipitate, and 4 parts of No. 7 cotton linters which had previously been ground in a large Wiley mill having a 4-mm. exit screen. The Cottrell precipitate was dispersed into the air stream at a rate of about 1 gram per 1,000 cubic feet of air, and the cotton linters were dispersed separately after each 20-gram increment of Cottrell precipitate. Arrestance determinations were made initially and at selected intervals in the dust loading process.

4. Results

The amount of dust fed to the filter, the pressure drop across the filter, and the dust arrestance are presented in Table 1. The first series of values were obtained with the filter in the as-received condition. The second set of values were obtained after washing and reapplying adhesive. The results are presented graphically in Figure 1.

It was estimated gravimetrically that the filter contained 29 g of adhesive in the first set of measurements and 18 g in the second set. This latter value was obtained after applying the entire contents of an aerosol spray can to the cleaned filter and redrying. A slight amount of lint (less than 1 g) was retained in the filter after washing.

The average arrestance based on the area under the curve was 41.7 percent in the first test and 48.4 percent after cleaning and reoiling.

From the lower curves in Figure 1, the original filter reached a pressure drop of 0.5 in. W.G. when 340 g of dust had been fed to the filter. Correcting for loss of dust due to fallout and dividing by the area of the filter, the filtration capacity was found to be

$$\frac{340 \times 0.928}{2.19} = 144 \text{ g/ft}^2 . \quad (2)$$

For the cleaned and reoiled filter the value was

$$\frac{269 \times 0.909}{2.19} = 112 \text{ g/ft}^2 . \quad (3)$$

In Table 2 the filtration capacity, average arrestance of Cottrell precipitate, and initial pressure drop are compared with requirements for a 1-inch Type-I viscous impingement filter according to Federal Specification FF-300a.

Table 1

Performance of Standard Filter Corporation Metal Viscous
Impingement Filter at 360 ft/min.

Measurement of filter as received

| Dust ¹ fed to filter (grams) | Pressure drop (in. W.G.) | Arrestance ² of Cottrell precipitate (percent) |
|---|--------------------------------|--|
| 0 | 0.035 | 40.8, 33.1, 38.2 |
| 50 | .055 | - |
| 133 | .106 | 38.7, 39.2 |
| 263 | .260 | 30.0, 42.5, 44.6 |
| 309 | .368 | - |
| 330 | .453 | 50.0, 48.9 |
| 355 | .572 | 50.0, 50.4 |
| 361 | - | - |

Measurement after cleaning and application of fresh adhesive

| | | |
|-----|-------|------------------|
| 0 | 0.034 | 47.0, 39.2, 44.6 |
| 48 | .050 | - |
| 131 | .114 | - |
| 173 | .163 | 48.5, 48.0 |
| 197 | .204 | - |
| 260 | .447 | 58.8, 57.1, 57.3 |
| 286 | .634 | - |

1. At the end of the first test 26.1 grams of dust were collected from the duct upstream from the filter. If it is assumed that the fraction of dust lost due to fallout was uniform throughout the test, the corrected amount of dust reaching the filter would be obtained by multiplying each of the values from the first test by the factor 0.928. At the end of the second test 26.0 grams of dust were collected upstream, and the factor to be applied to the second set of values is 0.909.
2. Two grams of dust were required for each arrestance determination. These weights are included in the subsequent dust fed to the filter.

Table 2

Comparison of Performance of Standard Filter Corporation
Viscous Impingement Filter with Requirements for a 1-inch
Type I Filter According to Federal Specification FF-300a

| | Filtration capacity (g/ft ²) | Average Arrestance Cottrell ppt. (percent) | Initial pressure drop (inches) |
|---------------------------|--|--|---|
| Filter as received | 144 | 41.7 | 0.035 |
| Washed and reoiled filter | 112 | 48.4 | 0.034 |
| FF-300a requirement | 150 | 50 | 0.08 |



